Summer 2024

Community Boating Center Bioluminescence Intern

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COLLEGE OF THE ENVIRONMENT

WESTERN WASHINGTON UNIVERSITY
MAKE WAVES.

Internship Title: Bioluminescence Intern

Organization Worked For: Community Boating Center & AmeriCorps

Student Name: Eddie Nosal

Internship Dates: 6/1/24 10/1/24

Faculty Advisor Name Dr. David Shull

Department ESCI

STUDENT SIGNATURE Eddie Nosal

DATE: 8/15/24

ABSTRACT

2024 is the third year of the bioluminescence internship position at the Community Boating Center. In the last two years, the Community Boating Center has partnered with Western Washington University to assist in research on bioluminescence and education through guided night kayak tours. Previous research was done by now-WWU alumni Lucy Greeley and Carrley Smith with the goal of identifying bioluminescent dinoflagellate species, planktonic community composition during bioluminescent events, and the effects of environmental factors on brightness of dinoflagellates. The work done by previous interns has gained recognition from the Bellingham Herald, presented at conferences, and has had a video feature by PBS Terra. Due to changes in funding and the availability of mentorship for research, the focus of the position shifted towards science communication and tour engagement this year.

INTRODUCTION

The Community Boating Center (CBC) is a 501(c)3 nonprofit organization located in Bellingham, Washington. Founded in 2006, the CBC fosters small-watercraft education, access, safe recreation, and marine stewardship, providing a variety of services in the form of rentals, classes, and programs for the Bellingham community and for those visiting.

One of the programs offered at the CBC is the bioluminescent night guided kayak tours. Running from June until the end of September, guests are led on a 3-mile roundtrip paddle to an enclosed embayment to view and interact with bioluminescent dinoflagellates and jellyfish. These tours would take place between Wednesday and Sunday nights, depending on the wind and weather conditions of Bellingham Bay. Participants are briefed on watercraft safety and

paddling techniques, fitted with spray skirts and PFDs, then assisted into tandem kayaks. These tours are typically led by me, a CBC kayak instructor, and a volunteer from the community. As the bioluminescence intern, my role on these tours consisted of assisting customers with getting on the water and serving as a naturalist by answering questions and giving a presentation at the embayment on bioluminescence, marine science, plankton ecology, and Pacific Northwest natural history.

Bioluminescence interns in the past have used these tours to collect plankton samples for research under the mentorship of Dr. Robin Kodner. Plankton tows were used to collect samples from the surface of the water, towed behind a kayak for 5 minutes. Samples would then be transferred into a 20 mL tube and fixed with Lugol's iodine to preserve the plankton and prevent damage from the refrigeration process. These samples would then be viewed under a microscope for species identification and compared with environmental factors such as wind, temperature, time, tide, and moon illumination. Environmental DNA samples were also collected in the past, with samples being poured into a filter chamber that was vacuumed to filter plankton out for DNA sequencing.

Previously working at the Lakewood Boathouse, the CBC has been a familiar place to me that shares a common goal of making watersport recreation more accessible to the community. Beginning this position in June, my goal was to utilize my academic background in marine environmental science as well as my experiences working with watersport recreation to give guests an unforgettable experience kayaking in bioluminescence and fostering environmental stewardship in our community. Although the internship looked different from the previous years due to funding and mentorship constraints, this position allowed me to gain familiarity with

laboratory and field sampling equipment, as well as practical experience with science communication during tours and as an ambassador to the CBC.

RESEARCH

Bioluminescence is a largely misunderstood concept in marine science that has not received a lot of attention in research. Previous interns Lucy Greeley (2022) and Carrley Smith (2023) have dedicated an immense amount of time and effort towards research projects under the mentorship of Dr. Robin Kodner, allowing the position to expand and continue into the contiguous year. Lucy's objective was to identify the Salish Sea community composition of dinoflagellates that had the potential of being bioluminescent, using eDNA sequencing and microscopy. Air temperature was identified to be an environmental factor influencing species richness. 7 potentially bioluminescent and 4 known bioluminescent dinoflagellates were identified, including *Noctiluca scintillans*; a dinoflagellate species found worldwide theorized to have lost its ability to produce light in the Pacific Northwest (Valiadi et al. 2019). Carrley's research looked to address the theory of *N. scintillans* losing its ability to produce light by identifying community composition of bioluminescent plankton using microscopy and assess the effects of environmental factors such as wind speed, air temperature, current speed, and moon brightness on bioluminescence, community structure, and abundance. Carrley's findings were consistent with Lucy's and were able to build on the environmental factors tied with the community composition of bioluminescent dinoflagellates.

At the start of the internship, the CBC applied to the Washington Sea Grant's SoundToxins program to receive funding for three research projects under the mentorship of

Northwest Indian College and Western Washington University professors. Research topics involved the usage of tour guest cell phone cameras to record the luminescence of collected samples, determining bioluminescence's capability of predicting harmful algal blooms, and a personal project comparing daytime and nighttime plankton community composition. However, the inability to secure adequate funding from the Washington Sea Grant resulted in the unfortunate termination of the research plan.

From June through July, several attempts were made to start a personal research project using resources and lab spaces available from professors at Western Washington University and professionals in DNA sequencing and marine science research. These attempts were also unsuccessful due to the limited availability of professors and output available by professionals in the field. Working under the Director of Youth Programming of the CBC, Sara Welsh, the hope is that we can work on applying for grants for the future of this position. To better prepare the next intern, I worked to put together a wish list of supplies and equipment that would benefit bioluminescence research, with the hopes of organizing an active fundraiser that would continuously fund the research.

Despite the loss of research opportunities under the mentorship of professors, I continued to gain field, laboratory, and research experience by using plankton tows during the tours to collect bioluminescent plankton to show participants on the water. The tow would glow from the plankton stuck to the net, allowing participants to touch a large concentration of bioluminescent dinoflagellates and hold jellyfish that were also bioluminescent. This opportunity also served as an educating moment for participants to learn about sampling techniques and plankton ecology. Samples collected from these tows would be brought back to the CBC and observed under a microscope to show guests the dinoflagellates responsible for bioluminescence. Cnidarian

species observed in the embayment were collected using the plankton tow and were identified as *Clytia gregaria* using microscopy, a Salish Sea dichotomous key, and photos from local dive photographers. I was fortunate to meet with MACS advisor, Dr. Jay Dimond, to discuss eDNA sampling and with the director of the National Center of Genome Resources, Dr. Callum Bell, to discuss DNA sequencing. These meetings have allowed me to gain insight on how these sampling techniques work as well as the processing and analyzation of the data collected.

SCIENCE COMMUNICATION

As a naturalist for the bioluminescent guided paddles, I have given a 10-minute presentation to each group once arriving at the embayment. This talk goes over what is causing bioluminescence in Bellingham Bay, the theories of why they produce light, deep-sea examples of bioluminescence, human history and usages of bioluminescence, and plankton ecology. I have read scientific articles on bioluminescence and have simplified the information I learned to present during the talks to minimize difficult scientific language, so that those who have little to no understanding of marine science can still comprehend what bioluminescence is. I have achieved this by explaining bioluminescence theories in a way that is relatable to the guest, by comparing the disruption of copepod feeding from bioluminescence to being disrupted by a bright light when eating dinner. I have been able to apply the knowledge I have gained from marine environmental science classes towards the tours by answering questions on plankton ecology, oceanography, and Pacific Northwest natural history.

Scientific information has historically been ineffectively relayed to the public, which this position aims to change. In a world where climate change and environmental issues continue to worsen and cause adverse effects to human health and populations, science communication has

become a critical tool to bring awareness to environmental problems that need to be addressed. Following the suite of previous interns, I am expected to give an hour-long presentation to the Bellingham community. In the past, this has been done in front of an audience of 150 people at Stemma Brewing Company and over zoom for 100 attendees. This year, the expectation is to do a presentation on bioluminescence as part of the "Salty Socials" event hosted by the CBC. My goal is to improve my public speaking skills and communicate scientific information to a large audience of varying understandings of environmental science to not only foster the CBC's mission of marine and environmental stewardship, but to gain experience communicating scientific information to the public.

Science communication, marine stewardship, and environmental education has not only been limited to the tours and the final presentation. I have been working to develop a three-hour lesson plan involving plankton ecology and bioluminescence for Bellingham community high schoolers. This plan would involve a classroom portion educating on the important role plankton play in marine and coastal ecosystems as well as the science behind bioluminescence, and a on-the-water portion where students would go out and collect samples to be analyzed under a microscope. The hope is that a program like this would not only deepen marine stewardship among a younger audience, but inspire some to consider marine sciences as a pathway in their future.

CONCLUSION & REFLECTION

Although research plans were unable to be followed as described in the position description due to minimal funding and available mentorship, I was still able to achieve my learning objectives by gaining familiarity with sampling equipment during tours and meeting with professionals in the field to learn on sampling techniques and what can be done with them.

The bioluminescence paddle tours have served as a great practical way of converting scientific research and information into something that the community can better understand and learn from. The final presentation will be a great experience to further grow my public speaking and science communication skills.

I thank my employers and fellow employees at the CBC for their hard work in making the tours happen, as well as their support for the work I have done so far. This internship has taught me that recreation is a overlooked method of science communication, environmental education, and way to bring awareness to environmental issues. I believe that the skills I have gained from this internship will help me establish a career in the world of marine science.

Internship Weekly Log

Week 1 (Jun2-8)

Bio paddles done: 1, 12 guests

Notes: Onboarding for internship, planning research project, research reading, starting biopaddles, onboarding with americorps,

Week 2 (Jun9-15)

Bio paddles done: 0, 0 guests

Notes: planning research project, biopaddles canceled due to wind and lack of participants, more research reading on bioluminescence, outreach to professors and professionals for assistance

Week 3 (Jun16-22)

Bio paddles done: 2, 17 guests

Notes: planning research project, grant was not approved, more research reading, outreach to professionals and other professors due to grant issues

Week 4 (Jun23-29)

Bio paddles done: 4, 27 guests

Notes: biopaddles getting more attention, meetings with Sara Welsh & Christine McCormick, planning for research project -trying to keep it alive

Week 5 (Jun30-Jul6)

Bio paddles done: 4, 33 guests

Notes: meeting w/ previous intern Lucy Greely, reading below the edge of darkness, reaching out to professors for mentorship, reading sci papers on bioluminescence

Week 6(Jul7-13)

Bio paddles done: 5, 53 guests

Notes: Continuing below the edge of darkness, biopaddles getting busier, organizing research project details, emailing professors for assistance with research

Week 7(jul14-20)

Bio paddles done: 2, 23 guests

Notes: Meeting w/ Jay Dimond on eDNA, emailing resources, reading below the edge of darkness, reading more on bioluminescence

Week 8(jul21-jul27)

bio paddles done: 1, 11 guests

Notes: research project not possible due to time & lack of resources, reading sci articles, below the edge of darkness, preparing for bioluminescence presentation

Week 9(jul28-aug3)

Bio paddles done: 4, 46 guests

Notes: Weekly meeting w Sara, preparing 3 hr lesson plan for high schoolers on plankton ecology and bioluminescence, planning for grants to apply to, emailing resources, started using plankton tow net

Week 10(aug4-aug10)

bio paddles done: 4, 47 guests

Notes: Meeting w Callum Bell on metagenome sequencing, planning presentation, reading sci articles, researching materials for wishlist

Week 11(aug11-aug18)

bio paddles done: 4, 48 guests

Notes: preparing presentation slides, researching wishlist items, polishing website blurb, finishing up lesson plan for high school students

REFERENCES

Valiadi, M. et. al. 2019. Molecular and biochemical basis for the loss of bioluminescence in the dinoflagellate Noctiluca scintillans along the west coast of the U.S.A. *Limnology and Oceanography*, 64:6.